Using Graphics Effectively

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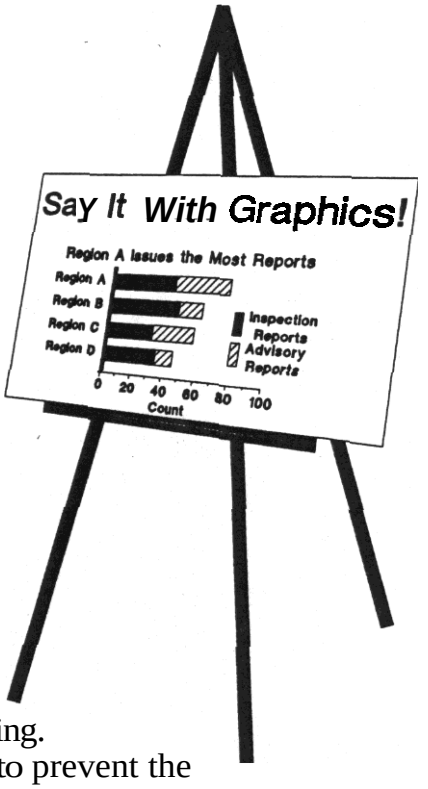
Introduction

Graphics are valuable tools which can be used to increase the effectiveness of our reports or briefings. However, as with any tools, they must be used carefully and judiciously. A graphic's message should flow from the narrative and present information to decision makers as simply as possible. We must pay considerable attention to the purpose, message, and clarity of all graphics. Creating and using graphics is as much an art as it is a learned skill and often requires a lot of trial and error. Hopefully, this technical assistance guide will 1) provide an understanding of graphics fundamentals, 2) increase the effectiveness of your graphics, and 3) minimize graphics errors.

Unlike the first seven guides which were professionally typeset and printed, this guide was produced solely with OEI regional office resources. This was done to illustrate the utility of WordPerfect and commercially available graphics program. All graphics were constructed using graphics program such as Arts and Letters Editor, Draw-Pafect and Harvard Graphics. These graphics were imported into WordPerfect and the document printed with a laserjet printer using typefaces available from Digital Typeface Corporation.

Development of this guide has been a collaborative effort involving many different people within OEI. Using preliminary work by Michael Hendricks of MH Associates, Kevin Golladay in the Dallas office authored this guide with assistance from other Dallas regional staff. Other OEI contributors were Bill Moran who provided overall direction for the guide, Dave Wright who provided editorial review, and regional and headquarters staff who provided draft review and comments.

The Power of Graphics

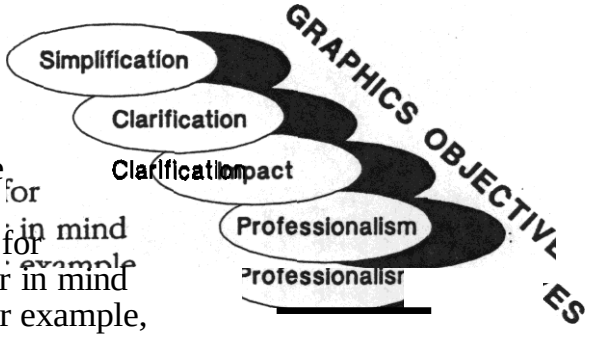


The primary goals of our reports or briefmgs are to present findings, make recommendations, and persuade decision makers to accept them. Thus, our reports or briefmgs must provide information which is easily understood and convincing. The problem facing each OEI project team is finding ways to accomplish this goal. In large measure, achieving this goal is affected by the inspection findings, the organization and flow of the report, the project team's writing style, the audience, and the project team's ability to formulate a convincing logical argument.

Graphics serve as a tool to aid us in accomplishing our written or oral presentation goals. Whether it is to enhance a report or presentation, or to help find hidden meanings in a mass of inspection data, graphics are beneficial. Graphics *can* efficiently communicate one or more ideas and will often drive a point home more quickly and convincingly than if we tried to describe our point orally or, particularly, in writing. Highlighting important information with graphics helps to prevent the audience or reader from missing or misinterpreting the message. Even if we only use graphics for our own inspection analysis, the different perspectives on data can be invaluable.

Since our memories and thoughts are largely pictorial, we often remember an image long after we have forgotten prose. Studies prove that we remember approximately 30 percent of what we see and only 10 percent of what we read. Defined as the simultaneous presentation of words, numbers, and images, a graphic *can* truly be worth a thousand words.

Graphics are useful because they can be used to achieve many general object-



inspection reports. A brief discussion of these objectives helps to determine when and for what purpose graphics are needed. Bear in mind that these objectives are interrelated. For example, whenever a point is simplified with the use of a graphic, the point is also clarified.

Simplification

While we have a lot to say in our reports or briefings, our audiences often do not have the time or inclination to examine and synthesize this information. Consequently, we must present our audience with a digest or simplification adequate to sufficiently comprehend the message. Graphics *can* break up a complex message into its components while maintaining the quality of the whole. Such graphics are especially effective as a complement to the narrative. Additionally, graphics can be used to convey a lot of information while taking up only a small amount of space in the report. Since we work very hard to keep our reports brief, graphics are excellent tools for achieving brevity while still providing the reader with a significant amount of information which can be digested quickly.

Clarification

Audiences require information which leaves little doubt of the intended message. Without clear messages, audiences may be confused. Considering the complexity of the material often dealt with in inspections, narrative text of complex relationships alone may 1) obscure the point, *2)* present excessive ambiguity, or 3) intimidate the audience. Graphics can often make narrative material clearer.

Impact

Our reports or briefings are just a small part of the volume of information our audience must deal with daily. Nothing is more boring to a policy maker than reports consisting solely of narrative. Policy makers are bombarded with too much narrative information to review and understand it all. Anything which may capture their attention and influence them to review a report will help. Graphics can be very beneficial in this regard. Graphics provide an alternative to tedious text and also serve to break up narrative in a way that provides the reader a refreshing break. Audiences often focus on and remember more a report or presentation which uses graphics effectively. Consequently, the addition of graphics may increase the report's or briefing's impact.

Professionalism

Graphics contribute to the credibility of a report or briefing for many reasons. Graphics present information in a precise and accurate manner. Often people are more likely to accept the validity of data in graphics over the same data in a narrative format. Narrative information often contains conditions, provisos, and explanations. It is far more difficult to "hedge" the meaning of a graphic's message.

As computer technology has allowed the incorporation of more and more visuals into presentations and written documents, expectations of audiences have risen. Audiences are beginning to expect sophisticated presentations and are likely to be bored by one consisting solely of words. A great orator like Winston Churchill or a great writer like Shakespeare could rivet an audience with only words; most of us need the help graphics offer.

Graphics Traps

When creating and using graphics, you should avoid several traps:

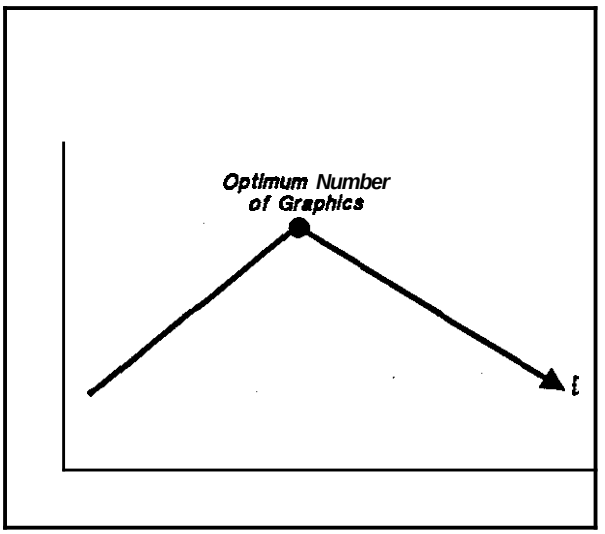
- *Sensory Overload*
- *Artistry Gone Wrong*
- *Missing Attribution*
- *Distortion*
- *Inconsistency*

Sensory Overload

Sensory overload occurs when too much information on a graphic confuses the reader. To avoid this, decide in advance which point you are trying to make, and then graph only those data which will emphasize the point. Graphics are usually best when they deliver one message per graphic in the most efficient way possible. Further, remember you don't have to use every feature available in a graphics program. Too many font styles, line widths, shading patterns, colors, etc. may confuse the reader.

The number of graphics used should also be considered. The quantity of graphics increases the efficient communication of information and interest of the reader *only up to a point* (the optimum point). Beyond this point, as Figure 1 shows, additional graphics have a negative rather than a positive effect and they likely increase reader confusion. Remember, if we emphasize too many of the messages in our report with graphics, the result may be that we emphasize very little. Stated more succinctly, "to emphasize everything is to emphasize nothing."

Figure 1



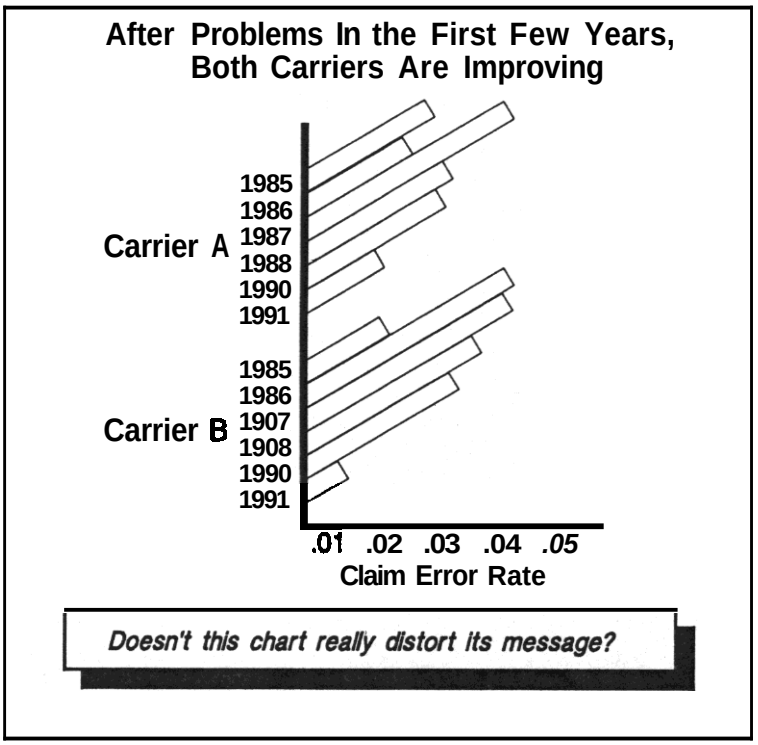
The number and complexity of graphics are dependent on the nature of the data and the sophistication of the audience. Some reports *can* benefit from many graphs

which augment the presentation of information while others should use very few or none. Determining the point at which graphics become confusing is difficult, primarily because a report's audiences vary in sophistication and graphics acceptance. Consequently, what may be beneficial to one audience may not be to another. Determining when to stop including graphics and whether a graphic is well designed are left to the common sense of the project and report review teams.

Artistry Gone Wrong

Another common trap occurs when we get so wrapped up in the artistry of a graphic that we lose sight of the analytic and presentation objectives. Figure 2 is an example of artistry gone wrong. A horizontal bar chart slants upward in such a way as to defy interpretation.

Figure 2



The person constructing the graphic might justify the distortion on the grounds that it matches an upward movement of prior graphs in the report and "catches the reader's eye." Unfortunately, this is a very weak justification for lessening the clarity of the graphic. Keep in mind that artistry is ***not*** a trap if it makes the graphic more effective by attracting and maintaining the reader's interest without obscuring the objectives of the graphic.

Missing Attribution

Each graphic within a report should clearly indicate the source of the information depicted even if the source of information is our own inspection data. While the text of the report might clearly indicate or allude to the source, readers may not have read

the narrative. Attribution is easily accomplished by including a footnote within the graphic. Failure to adequately specify a graphic's source can weaken or even negate its purpose. Further, failure to specify the source might cause the reader to question the validity or importance of other information within the report.

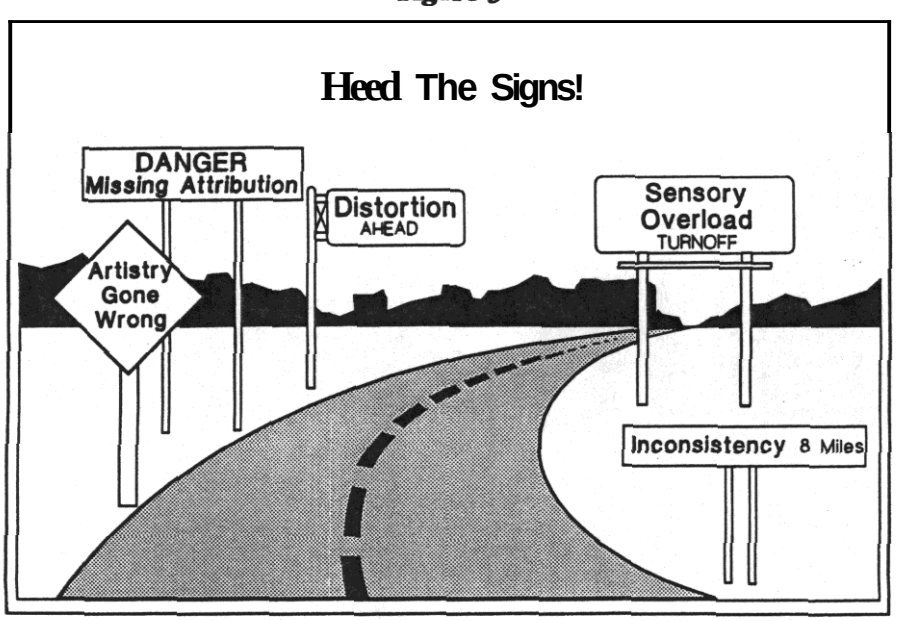
Distortion

you've heard the one about "lies, damned lies, and statistics." Well, the difficulty with statistics and graphics is one of awareness; you may not even know your graphic is lying or, more typically, distorting and complicating an idea. Software packages encourage you to "play" with data, not to understand it. Just because your package has a horizontal cluster bar chart format does not mean you should stick any data in the blanks and be done with it. You must first determine if the horizontal bar chart accurately reflects the "true" meaning of the data.

Inconsistency

Throughout an inspection report or presentation, a certain level of graphics consistency is critical. Graphics techniques should be the same in similar graphics. For example, equivalent graphics components (headings, axes labels, footnotes, data point labels) should all be the same size and font style from graphic to graphic (e.g., don't use a 12 point sans-serif title on one graphic and a 14 point serif title on another). Keep such items as shading patterns, line thicknesses, use of borders around graphics, and overall graphics sizes as equivalent as possible. If deviations are required, have a *clear* purpose for them. A lack of consistency will detract from the quality of a report or presentation. When inconsistencies exist, the reader may begin to question if inconsistencies also exist in the actual message of the graphic or report. Remember, above all, heed the warning signs and do no harm to a report or presentation with graphics. (See Figure 3.)

Figure 3



Steps to Effective Graphics

Because of the different uses and objectives of graphics, inspections staff must be able to use them effectively. Our graphical competence, like our written and verbal literacy, affects how persuasively we convey our important messages. This Guide presents seven steps for using graphics effectively:

1. *Determine the message*
2. *Decide what kind of graphics can be used to convey the message*
3. *Select the graphics* type *which best conveys the message*
4. *Construct the graphic*
5. *Check the graphic* for *accuracy*
6. *Pilot-test and revise the graphic, if necessary*
7. *Insert the final graphic into the report or briefing*

Additionally, this Guide discusses some differences between graphics which are better suited for written reports and those better suited for oral briefings. As we will see, graphics which strengthen a written report may actually weaken an oral briefing, so we must tailor our graphics to our medium.

Despite conventional wisdom, the most important tool for developing effective graphics is not the computer. The most important tool is our brain. The computer is a marvelous tool to translate our good ideas into striking reality, but only if we first have good ideas to translate. Simply because a computer generated a graphic does not mean the graphic will present a clear and analytically correct message. For this reason, the most important steps for creating and using graphics occur before ever touching the computer keyboard.

Before we discuss the steps to effective graphics, you may be wondering how to determine whether your report or briefing even needs graphics. As discussed previously, the fact is most reports or briefings could benefit from some graphics use. However, the question of what information, if any, in a report should be graphed depends on the nature of the information to be presented. Ideally, the most important messages in the report and information which could clarify an important point are likely candidates. What is often difficult is determining which are the most important points. Graphics options could easily be discussed or solicited during the inspection's story conference.

Step #1: Determine tbe message

The first step, and in many ways the most critical, is to determine our message. what exactly do we want to say? Or, more accurately, what do we want the viewer to learn? If we cannot state our message, we cannot even begin to design our graphic. Conversely, once we determine our message, excellent designs for our graphic often become obvious.

We can best clarify our message by writing it in one sentence. For example, "performance improved steadily until the 1987 legislative changes," "most complaints come from first-time beneficiaries," and "more experienced administrative law judges are more willing to grant extensions.' Since each message implies certain types of graphics, knowing our message makes it possible to design graphics alternatives to text.

Having developed a compact message sentence, we *can* make it the actual title for the graphic. This will convey more information than the *dry,* uninformative alternatives of "Performance Over Time," "Sources of Complaints," or, worst of all, "Administrative Law Judge Experience and Willingness to Grant Extensions."

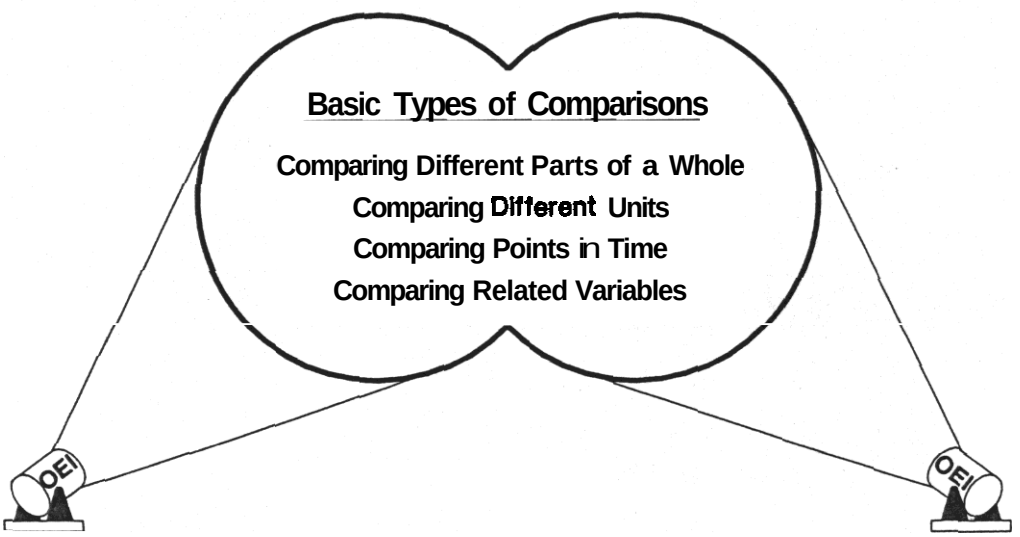
Step #2: Decide what graphics can be used to convey the message

An integral part of most types of graphics involves making comparisons. These types of graphics compose the bulk of traditional graphics (e.g., pie, bar, line) and will be referred to as "comparison graphics."

Several other types of graphics do not neatly fit under the category of comparison graphics or simply do not make comparisons using quantitative data. These types of graphics might serve such purposes as the expression of concepts or events (e.g., flow charts) or are simply intended to interest or affect the audience (e.g., pictorials). These types of graphics will be referred to as "specialized graphics."

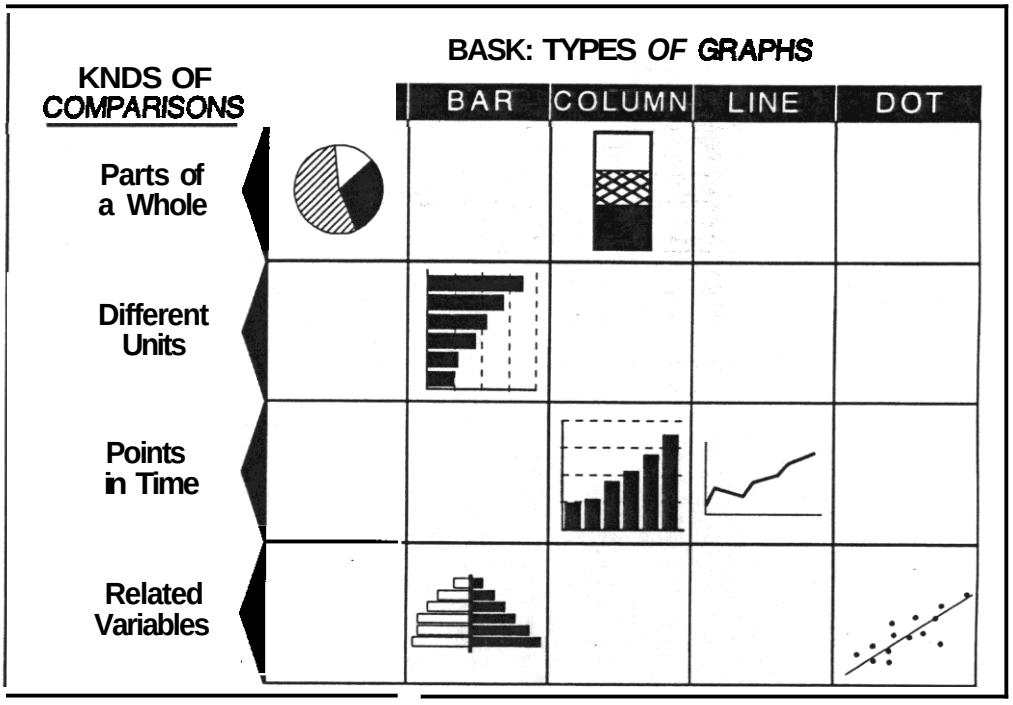
• Comparison Graphics

Technical Assistance Guide #5, Analyzing the Information Gathered, reminds us that comparisons are the essence of any analysis. Without comparisons, we may have a description, but we will not have an analysis. The question remains, "Compared to what?" Determining the proper comparison(s) is always one of the critical decisions of any analysis plan. For the purposes of this Guide, however, once this decision has been made and the analyses conducted, it may be obvious which types of graphics best present the comparison. There are basically four comparisons.



These comparisons imply certain types of graphics. Figure 4 depicts the most basic types of charts used when making different types of comparisons (a more complete discussion of graphics options is provided in a later section entitled Types of Graphics).

Figure 4



While these are the four main types of comparisons, we can create even more possibilities if we combine types or add new elements. The important point, however, is to realize that each message sentence implies a specific type of graphical comparison. Recognizing this fact and identifying the proper comparison for our message are critical steps in developing the most appropriate and effective graphics.

The following are a few key words to look for in the message to help identify the type of comparison.

Parts of the Whole:	*Percentage*	*Sum*
	Total	*Share*
	Ratio	*Proportion*
	Contribution	
Different units:	*More than*	*Ranks*
	Range	*Fall into*
	Less than	*Higher*
	Equal to	*Lower*
	Better	*Worse*
		Distribution
	How many	*How often*

Points in Time:	*Change*	*Decline*
	Decrease	*Grow*
	Increase	*Now/then*
	Rise	*Fluctuate*
	Fall	
Related Variables:	*Related to*	*Changes*
	Increases with	*Decreases with*
	Varies	

- **Specialized Graphics**

As discussed, some graphics serve a purpose other than strictly comparison. These graphics usually describe or explain something, visually affect the reader, or enhance comparison graphics. For example, flow charts are excellent vehicles to describe processes. On the other hand, pictorials and photographs can be very effective in catching the reader's eye and impressing a visual image on the reader.

Specialized graphics often require far more creativity than comparison graphics and few rules apply to many of these types of graphics. The limits are often defined only by good taste and accuracy. Creating some specialized graphics requires an "I will do whatever it takes, use whatever program it takes, and take whatever time it takes to create the graphic" attitude. As an example, to create a flow chart depicting a process, use a specially designed flow charting program (e.g., Easy Flow). If the flow chart is simple enough, some presentation graphics programs (e.g., Freelance or DrawPerfect) or drawing programs (e.g., Arts and Letters Editor) may prove adequate. However, since these programs were not specifically intended for flow charting, expect to spend considerable time and effort constructing the graphic.

Step #3: Select the graphics type which best conveys the message

We can often present our message in several ways; one of our most critical decisions is to select which graphic is best for our specific purposes. There is no simple formula for making *this* decision. The decision requires a careful blend of substantive, statistical, and artistic sensitivities.

We *can,* however, apply some useful criteria to each possibility:

- Which graphic is most accurate? Which one best conveys our message and only our message without distorting the truth?
- Which graphic is *simplest?* Which one conveys the greatest number of ideas in the shortest time with the least ink in the smallest space?
- Which graphic is clearest? Which one lets us most easily and readily see the message by emphasizing the data?
- Which graphic is most visually and artistically attractive?

In some instances, we may not be able to choose between two equally good graphics. Consequently, we can simply develop both concepts further and decide between the two after pilot testing each one on outside viewers. Remember, do not consider a graphic in isolation. It should contribute to the unity and balance of the report.

The story conference presents a good opportunity to brainstorm about not only how to write the information gathered during an inspection, but how to present it visually as well. Groups can often come up with better graphics ideas than an individual.

Step #4: Construct the graphic

Having selected the graphic to present our message, the next step is to construct the graphic. At the time this manual was prepared, OEI had no requirements dictating what graphics software must be used. However, DrawPerfect is suggested for many types of comparison graphics because of its compatibility with WordPerfect. (See Appendix B for a discussion of compatibility.)

Regardless of the graphics program selected, there are points which should be considered to ensure quality graphics. First, we must understand graphics basics. If you are new to graphics, you may be unfamiliar with some of the basic elements of graphics. Second, the type of graphics chosen must coincide with the capabilities of the graphics software (see section entitled "Graphics Software"). Finally, consider some basic tips on good graphics design (see section entitled "Graphics Tips"). Just because software can produce a graphic does not ensure the graphic's usefulness.

Step #5: Check the graphic for accuracy

After constructing the graphic and before others see it, sit down and carefully examine the graphic. Check the spelling, punctuation, capitalization, and overall appearance; most importantly, check for numeric accuracy! It is ironic how much time some people spend analyzing data and then fail to spend time making sure the right numbers actually make their way into the graphic. The time spent reviewing the graphic could save you embarrassment or loss of credibility.

Step #6: Blot-test and revise the graphic, if necessary

Once we construct a graphic, does it convey our message as well as we hope? The only way to fmd out is to show the graphic to people unfamiliar with our findings. If possible, show them to people very much l i e the policy makers and program administrators who will be the audiences for our reports and briefings.

It is generally better to show copies of the graphic, rather than the originals. While an original looks better, in reality, most will receive a copy. One good strategy is to show a copy without the message title and ask "What does this graphic say to you?" Then show a copy with the title and ask, "Is this the message you saw?"

Based on viewers' reactions, we can 1) accept the graphic, 2) revise it as needed or 3) eliminate it from our report or briefmg. While we may have spent countless hours developing a graphic, we should not allow that effort to cloud our viewpoint when reacting to graphics criticism. There is little to be gained by defending the purpose

of the graphic in the hopes of convincing the reader of the graphic's merit. Your investment in the graphic is insignificant in relation to the quality of your inspection report. If the criticism is valid, determine if the graphic *can* be salvaged by making changes. If not, drop it and attribute it to a lesson in trial and error.

Step #7: Insert the final graphic into the report or briefing

Perhaps the best way to think of graphics are as visual paragraphs. Like narrative paragraphs, each graphic should present a clear message, have each component (legend, labels, etc.) support this message, and be internally coherent. *Also,* as with all other paragraphs, the graphic should be integrated into the report or briefing at the appropriate place.

The best place follows immediately after the graphic's message is first mentioned in the text or during the briefing. When a person reads or hears, "As Figure x shows...," she wants to see Figure x then, not two paragraphs later or on the next page. This means that written reports may have some blank spaces at the end of some pages. This is not ideal, but it is better than forcing the reader to stop reading the message in order to search for a graphic.

Logistically, we develop written reports with Wordperfect and one or more graphics software programs (e.g., DrawPerfect). While WordPerfect provides a means to insert our graphics directly into our text, this step must be done carefully. Consideration must be given to achieving the best quality (especially for final reports). Specifically, if the graphic imported into Wordperfect does not appear equivalent to the same graphic printed directly from the graphics program to the printer (e.g., shading patterns distorted or fonts changed), you may consider "cutting and pasting" the better looking graphic into the final report.

WordPerfect offers two methods of incorporating graphics into the document. (See Appendix A for an example of how to import and manipulate graphics in WordPerfect.) Either you can physically retrieve and store the graphic within the document or you can specify the location of the graphic (graphic on disk option). If the graphic on disk option is specified, Wordperfect does not physically incorporate the graphic but rather, merges the graphic for printing purposes only.

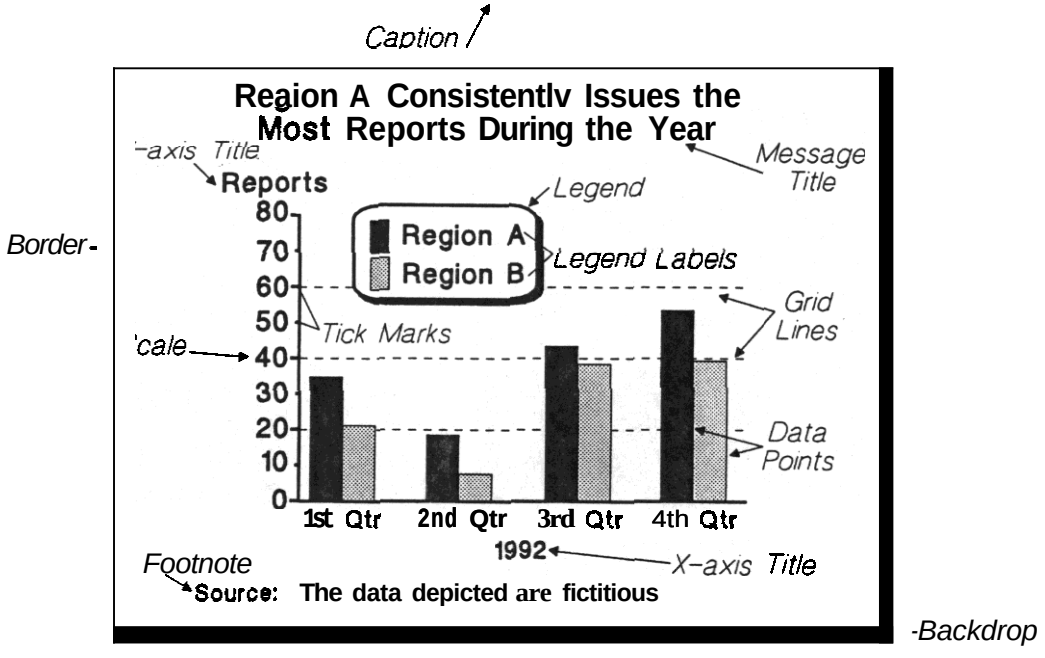
Each file imported into WordPerfect makes the file much bigger. Thus to make the document more manageable (smaller size file and less likelihood of encountering memory conflicts), use 1) the graphic on disk option or 2) do not import graphics into the document until you are ready for the final printing. You can create empty boxes and add the graphics file name later.

***Remember** to factor into the graph's construction the possibility that the graphic will be smaller or larger when imported into WordPerfect. Consequently, ensure that all text is readable and the graphic's size is acceptable.*

Graphics Elements

Like a scientist who studies the basic building blocks of nature, we too must understand the basics of graphics construction to ensure that we create an accurate graphic. Although there are many types of graphics, certain elements are consistent throughout most. Figure 5 shows many of the basic elements.

Figure 5



Title

Graphics should almost always have a title. This title should specifically state the graphic's message. Usually this message is emphatic and unambiguous. For example, the title "Medicare Costs and Services," although accurate, leaves the reader wondering just what the author thought was the important message. However, the title "Medicare Costs and Services Continue to Rise" tells the reader immediately that the graphic is meant to emphasize the fact that both costs and services are rising.

Axes

Two types of variables are connected with most graphics: an independent variable and a dependent variable. In some graphics programs, these are referred to as the category and the value, respectively. The graphics program automatically assigns each variable you enter to the appropriate axis and plots the points. Which variable goes on which axis is determined by the type of graphic you instruct the graphics program to create. For illustration, column, line, high-low, and area charts mark the independent variables (categories) along the horizontal axis (X-axis). The dependent variables (values) are marked along the vertical (Y-axis). A bar chart reverses this

relationship, measuring the independent variables along the vertical axis and the dependent variables along the horizontal axis. The pie chart and the scatter chart have their own methods of expressing this relationship (see "Types of Graphics" in the next section).

Data Points

Pairs of related numbers (e.g., a person's income over several years) are known as data points. Each pair is one data point in that the plotting of that pair produces one point on the chart. The group of data points required to plot one line, or one set of bars or columns, on a chart is called a series.

Grid Lines and Tick Marks

Grid lines and tick marks help determine data values in the plot area. Tick marks associate a label with a position on a scale. Grid lines are useful for determining exact data values. However, grid lines and tick marks should be used sparingly to avoid cluttering the graphic.

Footnotes

Footnotes add useful comments such as the data source or explanatory statements. A reader or an audience is more likely to accept the validity of a graphic's data if they are aware of the data source.

Sizing and Positioning Labels

To be informative, a graphic must be labeled with words, numbers, and other symbols. To be effective, these labels should be kept to a minimum and their size and typeface should be consistent. There is a hierarchy to labeling: size, weight, and shading are proportional to the label's importance. The title, in the largest letters used on the graphic, should be centered at the top. If a subtitle is needed, to qualify or support the title, it is placed beneath the title in smaller or lighter letters. Labels for lies, bars, and segments are next in importance, followed by the horizontal and vertical grid labels and the axis titles. Preferably, axis titles should be printed horizontally. The X-axis title is centered below the axis; the one for the Y-axis should either be centered on the axis or placed just above it. The units of measurement on the value axis should be clearly identified (e.g., millions of dollars). Footnotes should be in the smallest lettering used.

Borders

Your graphic should stand out from any surrounding text. Whether this is accomplished with borders or the judicious use of white space, the more the graphic is distinguished from its background, the greater the impact. The border or white space acts like a frame on a painting. It keeps the viewer's attention focused on the material inside of it,

Fonts

Most people never think much about the fonts used in a document or graphic. Some are simply not consciously aware of the influence and persuasive qualities of type. The size, weight, shape, and structure of a typeface can either engage or repel an audience or reader. Typography is the art of selecting and positioning fonts to cany particular meaning and should be considered in report and briefing graphics, where every word carries a lot of weight.

Fonts are defined by the shape of the letters. There are basically two main font types — serif (e.g., Times Roman and Dutch) and sans-serif (e.g., Swiss and Helvetica). Serifs are those little crosslines at the ends of letter strokes, designed to help readers follow lines of type across the page. The serifs form a path along the baseline the type rests on, drawing our eyes through dense areas of text. We are use to reading serif type in books and newspapers.

Sans-serif fonts lack the little crosslines. For years, we have read sans-serif type signs, graphics, and headlines. Sans-serif appears to be the font of choice for brief, important messages while serifs are the choice if considerable text is required.

Especially in briefing charts, serif fonts can look rather awkward and unfinished in the typical text slide or chart. However, serif fonts are preferred in the following situations:

- When you must include quite a bit of text on graphics (however, lots of text should be avoided on briefing charts).
- If you have a need for large capital letters or numbers as a design element. The serif type can evoke authority and classical design of the printed page.

Be sure to give sans-serif fonts plenty of room to display their form (puce between letters and words) and create a spatial balance. Steer clear of setting more than one or two words of sans-serif type in all-uppercase, because it isn't easy to read or separate into individual words.

Types of Graphics

There are many graphics options to consider. Many choices are listed in the table below and described more fully in the following pages.

COMPARISON GRAPHICS

Comparing different parts of a whole

Pie	Shows parts of a whole (e.g., ratios) at a given point in time.
Sliding Bar	Compares different parts of a whole, provided the whole has no more than two segments.
100-% Column	Shows the relationship of a segment to the whole.
Pie-Bar	The bar provides further detail on the composition of one slice.
100-% Area	Shows the distribution. Each band is proportional to its contribution to the *sum* of the bands.

Comparing *different units*

Bar (Horizontal)	Ranks many similar items or shows trends over many time periods
Segmented Bar (Horizontal)	Each segment indicates the value of an individual item while the length of the whole bar shows the total.
Clustered Bar (Horizontal)	Compares multiple items.
Deviation Bar (Horizontal)	Shows positive and negative values.
Range Bar	Displays fluctuation extremes by plotting a bar from an item's low value to its high value.
Histogram	Shows frequency distributions for two or more series.
Small Multiples	Compares different *units* using meaningful symbols such as circles varying in the extent of being Filed.

Comparing *different points in time*

Single Line	Shows fluctuations in data over time or sharp trends/changes over time for frequency, range, and distribution comparisons.
Multiple Line	Compares multiple series fluctuations or trends.
Area	Shows cumulative totals and changes in volume over time.
Column *(Vertical* Bar)	Illustrates changes or growth over time.
Deviation Column	Shows positive and negative values.
Range Column (high-low *chart)*	Especially effective at showing fluctuating ranges over time.

continued

Comparing different **points** *in time*	*(continued)*
Stacked Column (segmented vertical bar)	**Allows** comparison **of** individual segments **between** bars and comparison of the **full** heights of bars.
Historical Timeline	Compares events at different points in time.
Comparing relationships between multiple variables	
Scatterplot	Compares time periods **or** individual items **to** establish **correlations,**
Paired Bar	Shows correlations between different series **using** the same x-axis, **such** as claims volume versus **cost** of carrier **operations.**
Bubble	Shows relationships among three variables.

SPECIALIZED GRAPHICS	
Flow Chart	Shows a series of activities, procedures, operations, events, ideas, etc.
Time Chart	Presents work schedules **or** plans.
Map	Presents information for a geographic location(s).
Text *chart*	Highlights brief narrative (usually bullet text).
Table	Presents analytic **data** in **rows** and columns.
Pictorial	Displays information through pictures. Often used to interest the audience and highlight a message.
Pictograph	Enhances comparison graphics with **symbols or** *images.*

Comparison Graphics

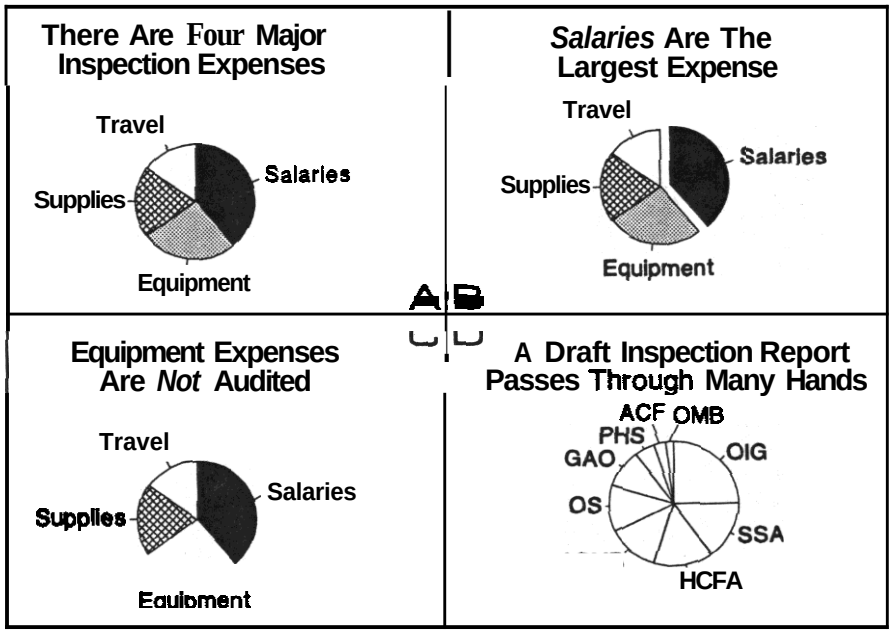
Comparing Different Parts of a Whole

- **Pie Chart**

Pie charts are the most common way to compare different parts of **a** whole. Some people consider it easy to compare the relative size of segments because they all emanate **from** the same point. This is especially true if the graphic is constructed **with** segments rotating around the pie in order of size.

Figure 6 shows that a pie can be "intact" (A) or "exploded" (B) to emphasize one or more slices (salaries), that a slice can be omitted (C) to stress its absence (equipment expenses), and that many slices (D) can represent a splintered situation (organizations reviewing an inspection report and how long it takes to get comments back). This last pie can be effective occasionally, but it should be used deliberately, since it is usually best to display at most 5-6 slices.

Figure 6

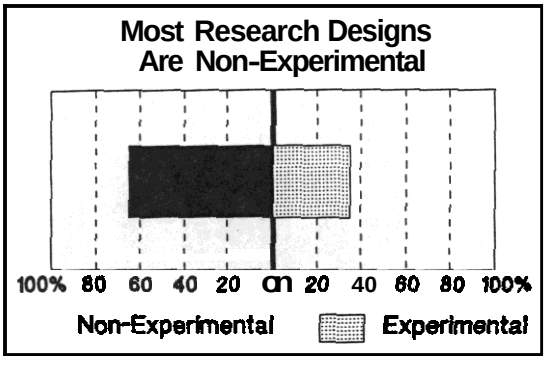


Some people dislike pie charts and argue that they should be used as little as possible. These people point out that to "decode" the relationships among different slices requires a viewer to compare either different angles where the slices meet or different areas of the pie-shaped sections, neither of which is an easy task for some people.

• Sliding Bar *Chart*

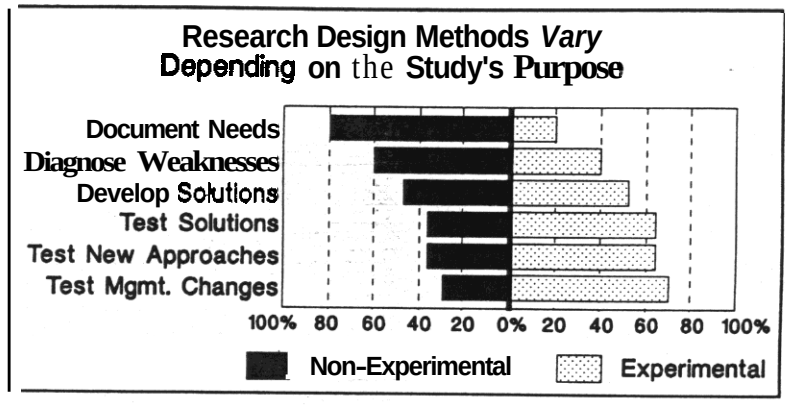
A sliding bar chart is another way to compare different parts of a whole, provided the whole has only two segments. This chart is created by dividing the graphic into two sides, each representing one condition or the other, and by displaying a bar which "slides" across the mid-point rather than being anchored to an X- or Y-axis. The proportion of the bar which rests inside each half of the chart illustrates the relative division of the whole. Figure 7 shows that 65 percent of *all* research studies used non-experimental methods, while 35 percent used experimental methods.

Figure 7



In the same way, sliding bar *charts* become considerably more interesting and useful when more bars are added. Figure *8* shows that Figure 7's *65-35* percent balance of research designs varies depending on the purpose of the study. Studies to document needs are heavily non-experimental (80 percent), while studies to test management changes were experimental (70 percent). Studies for other purposes show intermediate mixes of research designs. Comparing the positions of the different bars provides an immediate and intuitive grasp of the way each study's purpose "tilts" its research orientation.

Figure 8



• 100-percent Column Chart

In 100-percent column charts, also called 100-percent segmented bar charts, the values for the segments of each bar are in percentages and add up to 100 percent. The 100-percent column chart is essentially the same pie filling re-baked into a rectangular pan. (See Figure 9.) Several 100-percent columns *can* better portray the movement of time than a series of pies. People readily associate vertical bars with time series data. The arrangement of vertical bars moving from left to right corresponds better with the onward movement of time. A 100-percent column chart is decoded by judging the height of each section; studies have shown that we are more accurate at this task than we are at different angles or different areas. In other words, a pie and a 100-percent column chart both encode the same information, but a viewer *can* more accurately decode the column chart, especially if several columns are used. Additionally, we can help the decoding process by presenting the largest segments in order from the bottom of a column chart and clockwise starting at noon on a pie chart.

Figure 9

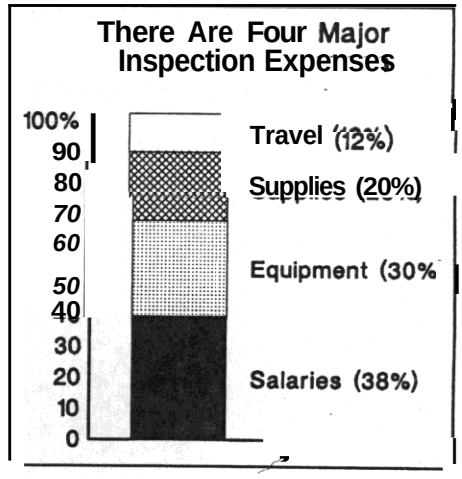
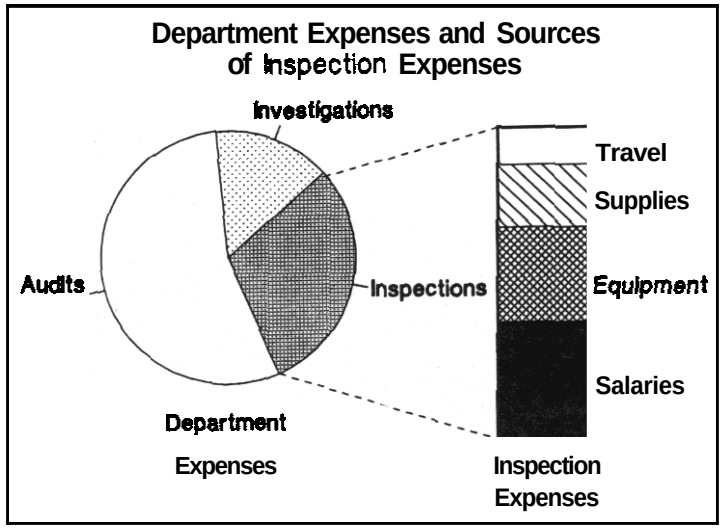


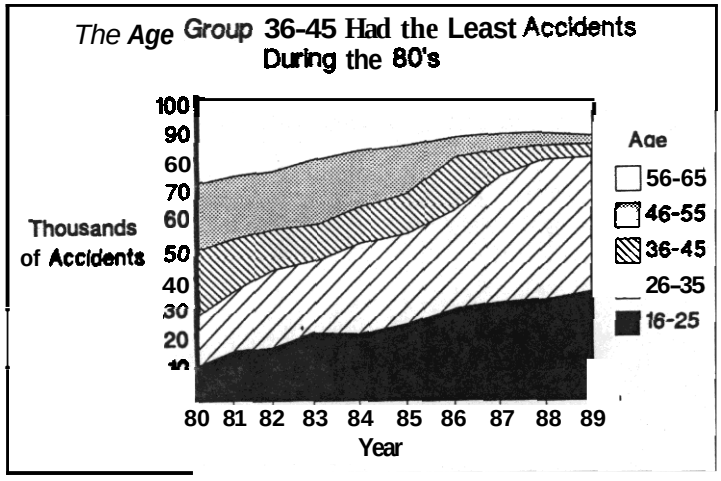
chart with a 100-percent column. (See Figure 10.) A single slice of the pie is sub-divided into parts in the form of a 100-percent segmented bar chart. This pairing is popular for displaying any data where one data set is further broken down into its components. Components should be ordered from the largest to the smallest. The slice which is broken down can be intact as shown in Figure 10 or exploded from the other slices.



- **100-percent Area** Chart

100-percent area charts show component comparisons, usually in conjunction with time series data. (See Figure 11.) The band representing the values for each period is merged into one broad, sweeping band, giving a sense of the whole. In contrast to the pie or bar charts, the shape of each area is usually very irregular and makes it difficult to compare

Figure 11

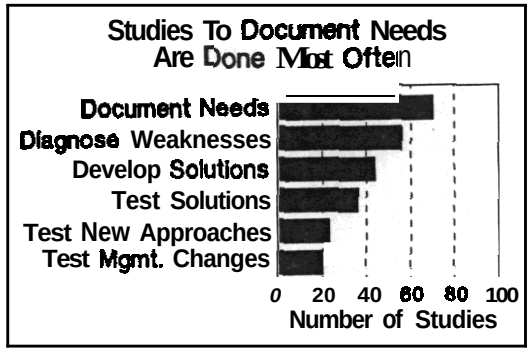


Units

- **Bar Chart**

To compare the relative contribution of different units to the total score, we use the graphics discussed above. However, to compare the absolute scores for each unit, bar charts are most common. Figure *12* shows that 1) these bars are horizontal to avoid suggesting a time dimension and 2) bars should typically be ordered.

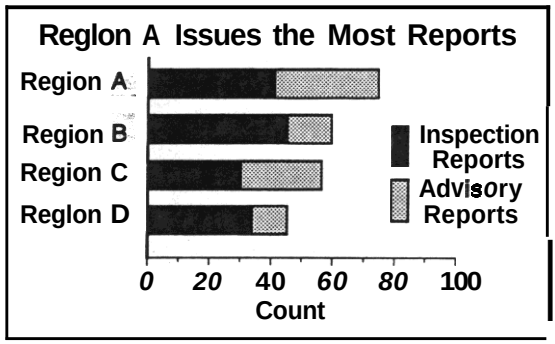
Figure 12



• Segmented Bar Chart

Segmented bar charts (sometimes called stacked bars) divide a bar into multiple parts. (See Figure 13.) Each segment indicates the value of an item while the length of the whole bar shows the total. Using this type of chart one can compare both individual segments between bars and compare the full lengths of the bars. Segmented bar charts *can* be formatted similarly to 100 percent column charts; each whole bar would then be of equal length and segments would represent percentage relationships

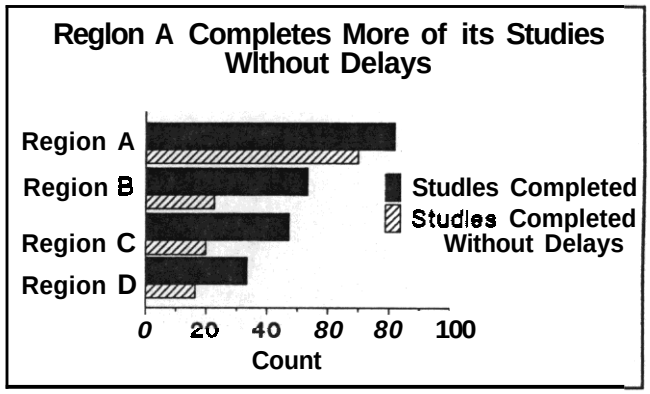
Figure 13



• Clustered Bar Chart

Like the segmented bar chart, clustered bar charts, sometimes called grouped bar charts, compare related sets of items. (See Figure 14.) This type of chart focuses attention on comparisons within each group rather *than* between groups. One disadvantage of this chart is that it must often be drawn in a large vertical size in order to make each individual bar a reasonable width if there are many groups. The number of bars in a group should be kept to four or less.

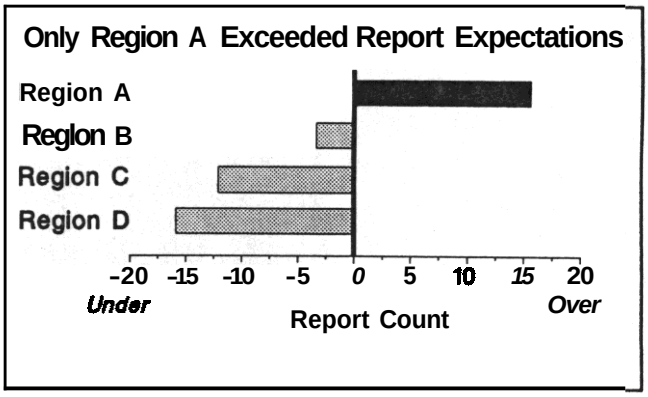
Figure 14



• Deviation Bar *Chart*

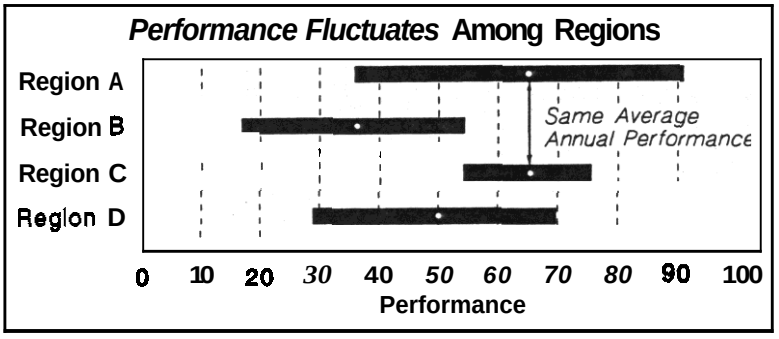
Deviation bar charts use the same raw data as a typical bar chart. However, the starting point for each bar is a single meaningful number such as 1) the overall mean score of all units, 2) the overall expected score across all units, 3) a minimum level of acceptable performance, or 4) zero. (See Figure 15.) With this new score as the starting point, some units will now have positive scores (or "residuals") while other units will have negative scores. The deviation of these residuals around the new starting point shows which units are above or below.

Figure 15



• Range Bar Chart

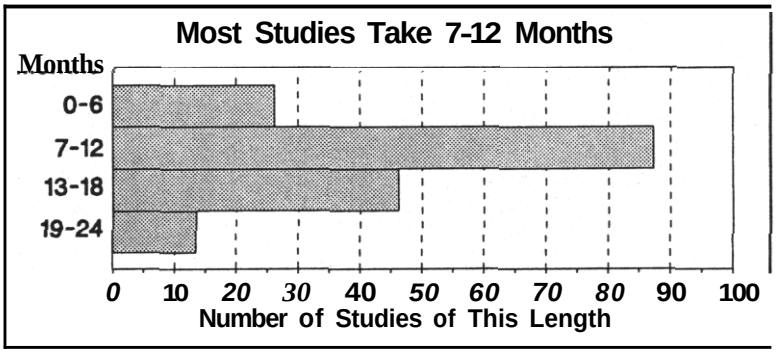
Figure 16



Range bar charts, unlike standard bar charts which show average or cumulative performance, show the variability of that performance. Figure 16 presents the performance ranges for four regions over the past ten years. Performance is simply the percentage of regions rated **below** the specified region. Note that two regions (A and C) have exactly the same average annual performance, but they have widely differing variabilities. This important finding would be hidden on a typical bar chart of performance.

• Histogram

Figure 17

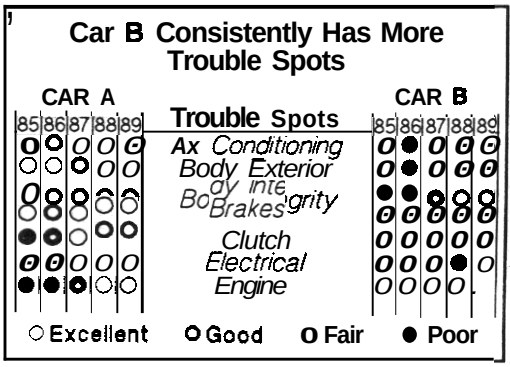


Histograms are especially effective for showing frequency distributions of data points among continuous segments. Basically, the histogram is just a bar or column chart with no spaces between bars or columns. The distinction between bar charts and histograms is based on the distinction between qualitative and quantitative variables. The values of qualitative variables vary in kind but not degree and hence are not measurements. For example, Region A in Figure 6 is a qualitative variable; while the regions were numbered A, B, C, and D they could equally well have been labeled with numeric values (1, 2, 3, etc.), but these values are only convenient codes. In contrast, values on a quantitative variable result from an actual measurement with some sort of "yardstick." For example, "months" to complete a study in Figure 17 is a quantitative variable. A good test for whether a variable should be regarded as qualitative or quantitative is whether you can identify a unit of measure (months, dollars, etc.). The width of each bar represents a single interval in the continuous range of numeric intervals along the vertical axis (bar histogram) or horizontal axis (column histogram). Figure 17 presents the number of studies taking different amounts of time to finish. Note that the overall distribution might change considerably if different sue segments were used (e.g., increasing segments from 4 to 24 — one per month). When creating histograms, it is usually helpful to experiment with different-sized segments.

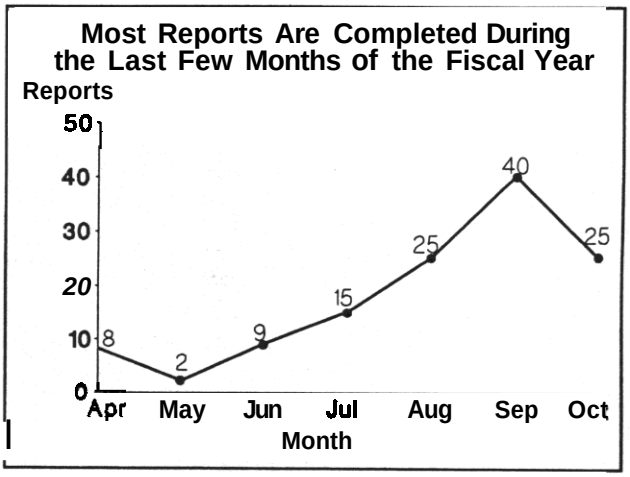
• *Small* Multiples

Small multiples are an especially powerful way to compare different units. Figure 18 presents the familiar Consumer Reports frequency-of-repair information for two fictitious automobiles for a six-year period. This graphic uses one simple symbol (circle) repeated many different times. Once a viewer learns the meaning of the **small** multiple, interpreting the graphic across repair dimensions, years, and different car models is easy.

Figure 18



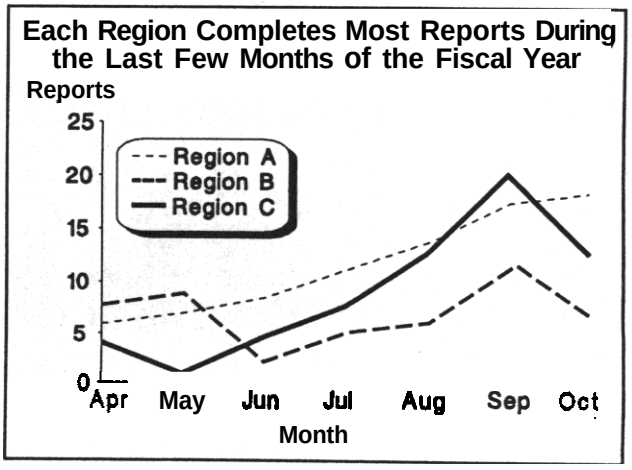
for one point in time, but often we need to display longitudinal patterns over time. (See Figure 19.) Line charts are the most popular graphic for these comparisons. Line **charts** are especially effective for presenting a large number of values in a compact space. For example, if we had data on the number of reports completed over the last five years by month, we could plot that data in a line chart. A bar chart, on the other hand, would either need to be very wide or have 60 very thin bars.



• Multiple Line Chart

Like single line *charts,* multiple line charts are useful for displaying data over time. The only difference is that multiple line charts compare the change over time for more than one item, where each line represents **an** item. (See Figure *20.)* More than 3-4 lines begin to clutter the graphic. Straight or curved lines can be fitted to the data points to make the overall trends more obvious.

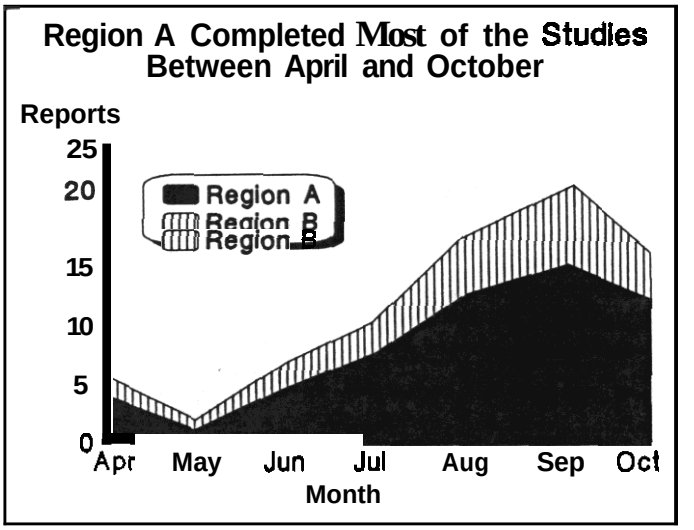
Figure 20



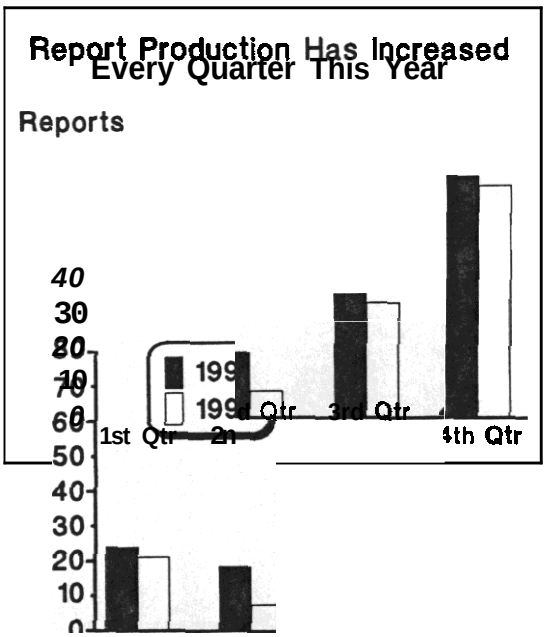
• Area Chart

Area charts, also called mountain or surface charts, are essentially line charts with the areas below each line filled in. The areas emphasize the sheer volume of the scores, although in practice it can be difficult to interpret the different shaded areas. Suppose you are graphing two series of numbers (A and B). In a line chart, like Figure 20, the line for each series may cross over other lines, making it difficult to comprehend. But in an area chart, area B could be physically stacked on top of area A. You can think of

Figure 21



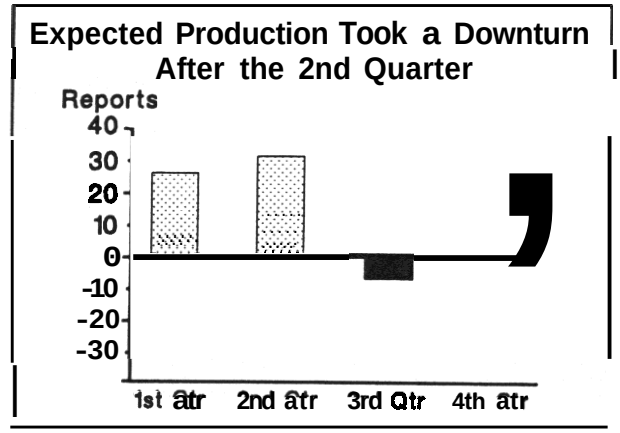
are best used to show the change of a single item over time. Each period of time has its own column. As you can see in Figure 22, the taller the column, the greater the value of the item. Because of their design, column charts emphasize differences from one time period to another are easy to spot. Figure 22 has multiple item (two bars per group) and is often referred to as a clustered vertical bar chart. Figure 22 could easily have included more than two item per group, but like line charts, should be limited to only a few. More than two or



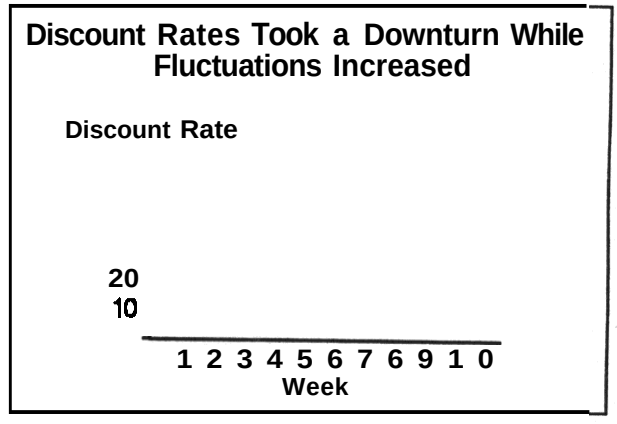
• Deviation Column Chart

Deviation column charts, like deviation bar charts, vary around a meaningful starting point. But, whereas deviation bar charts compare performance among different units, deviation column charts are especially effective at showing the variability of performance of one unit over time. Figure 23 shows the number of reports completed during the specified quarter in excess or short of the expected amount (the expected amount is the baseline from which the actual production is compared). This type of chart clearly shows the last half of the year did

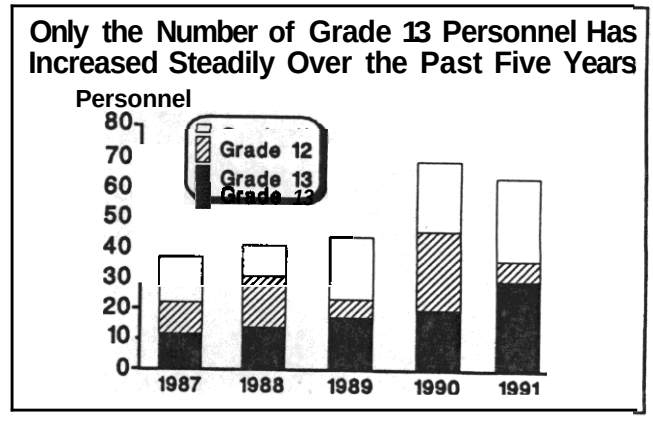
Figure 23



Range column charts, often called High-Low charts, like range bar charts, are especially effective at showing fluctuating ranges, but in this instance the fluctuations are over time. This particular graphic is often used to display a stock market's daily highs and lows. Figure *24* depicts not only the discount rate ranges for a ten-week period, it also clearly shows the trend. Figure *24* includes a line which represents the average rate at



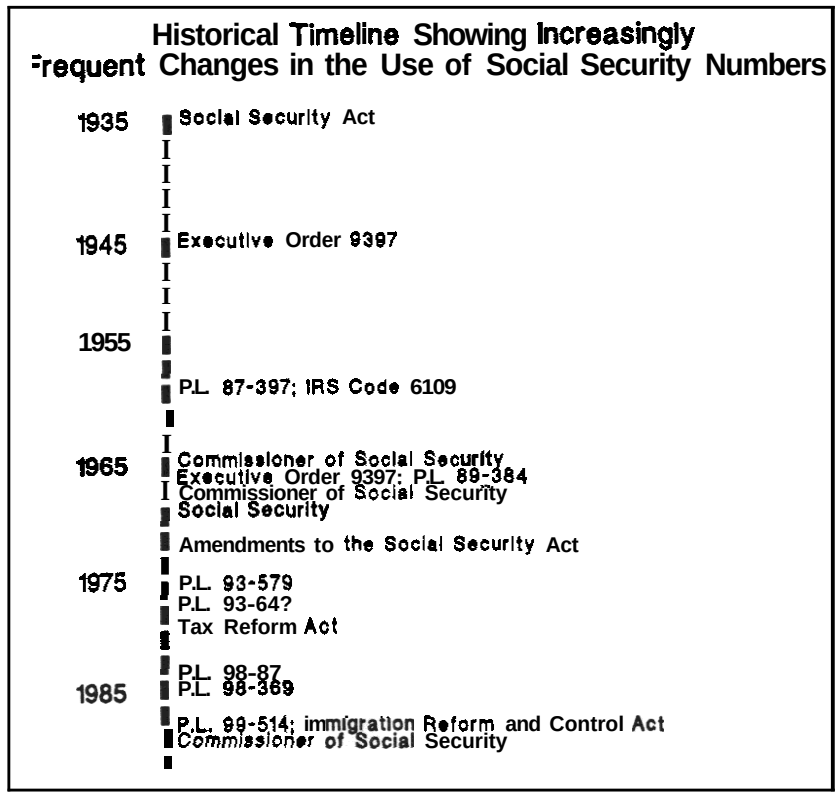
Stacked column charts, while common, are also controversial. Figure 25 shows that for stacked columns with only three segments, a viewer *can* judge fairly easily the size of each separate segment. However, with more segments, the interpretation becomes increasingly difficult. Like mountain charts, stacked column charts should be used very carefully.



• Historical Timeline Chart

An historical timeline is another option for comparing different points in time. Figure *26* reproduces part of a timeline from Technical Assistance Guide #1 — Focusing the Inspection. By pinpointing each change in the use of Social Security numbers, this timeline reveals a pattern of increasingly frequent changes. Similar timelines can not only enhance our findings but can help clarify our analyses.

Figure 26

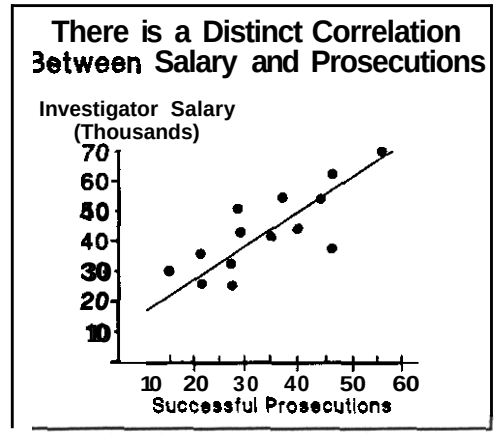


Comparing Relationships Between Multiple Variables

• Scatterplot

Scatterplots, also called *scattergrams* or dot charts, are the most common way to show the correlation or inter-relationship between two separate variables. (See Figure 27.) This is the familiar X-Y plot from basic research methods, with one variable plotted along the X-axis and the other plotted along the Y-axis. Markers represent each data set plotted. The more widely dispersed the points, the less correlation between the data. When markers begin to form a lie, a correlation exists between data. The more the markers cluster around a lie, the greater the correlation

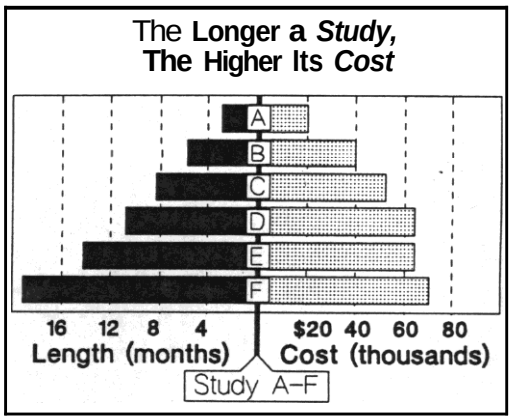
Figure 27



plots can hold a great many data points and that we can fit either a straight or curved line to reveal the overall relationship.) Scatterplots differ from most charts because both axes are numeric. ***Also,*** either or both of these axes can be linear or logarithmic. In previous charts discussed, an independent alpha variable is plotted against a dependent numeric variable. Because scatterplots are rather technical (i.e., require some statistical knowledge), they may be better suited for the appendix.

• Paired Bar Chart

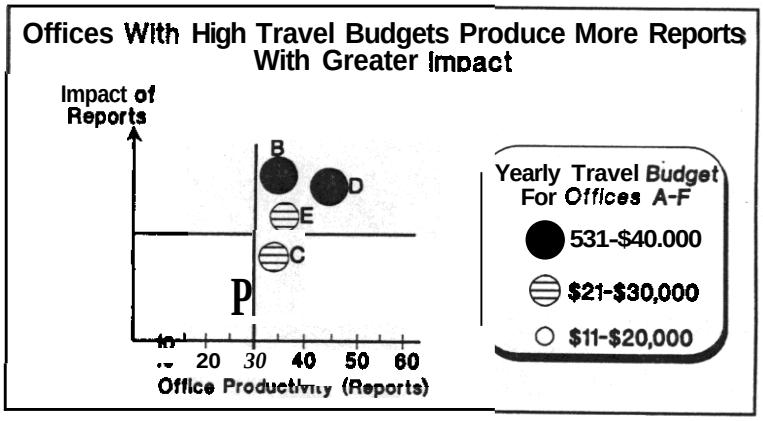
Figure 28



who might be unfamiliar with scatterplots. When there are relatively few data pairs (<15), the scores on the "independent" variables can be ordered down the left side of the graphic and the scores on the "dependent" variable can be correspondingly ordered down the right side. If the two variables are positively correlated (Figure 28), the two patterns will be almost *mirror* images of each other. If they are negatively correlated, the patterns will again be mirror images, but with one pattern inverted. And if

• Bubble Chart

Figure 29



If relationships between three variables need to be graphed, bubble charts are an alternative. Two of the variables position the bubble. The third variable changes the bubble's size which gives bubble charts their unique value. In Figure 29, office productivity (measured by reports produced) is plotted against the impact of the reports. The size of the

divided into quadrants. In Figure 29, the upper right quadrant represents offices with the greatest productivity and impact. The appearance in this quadrant of the two offices with the greatest travel budgets shows that travel budgets can indicate office productivity and impact.

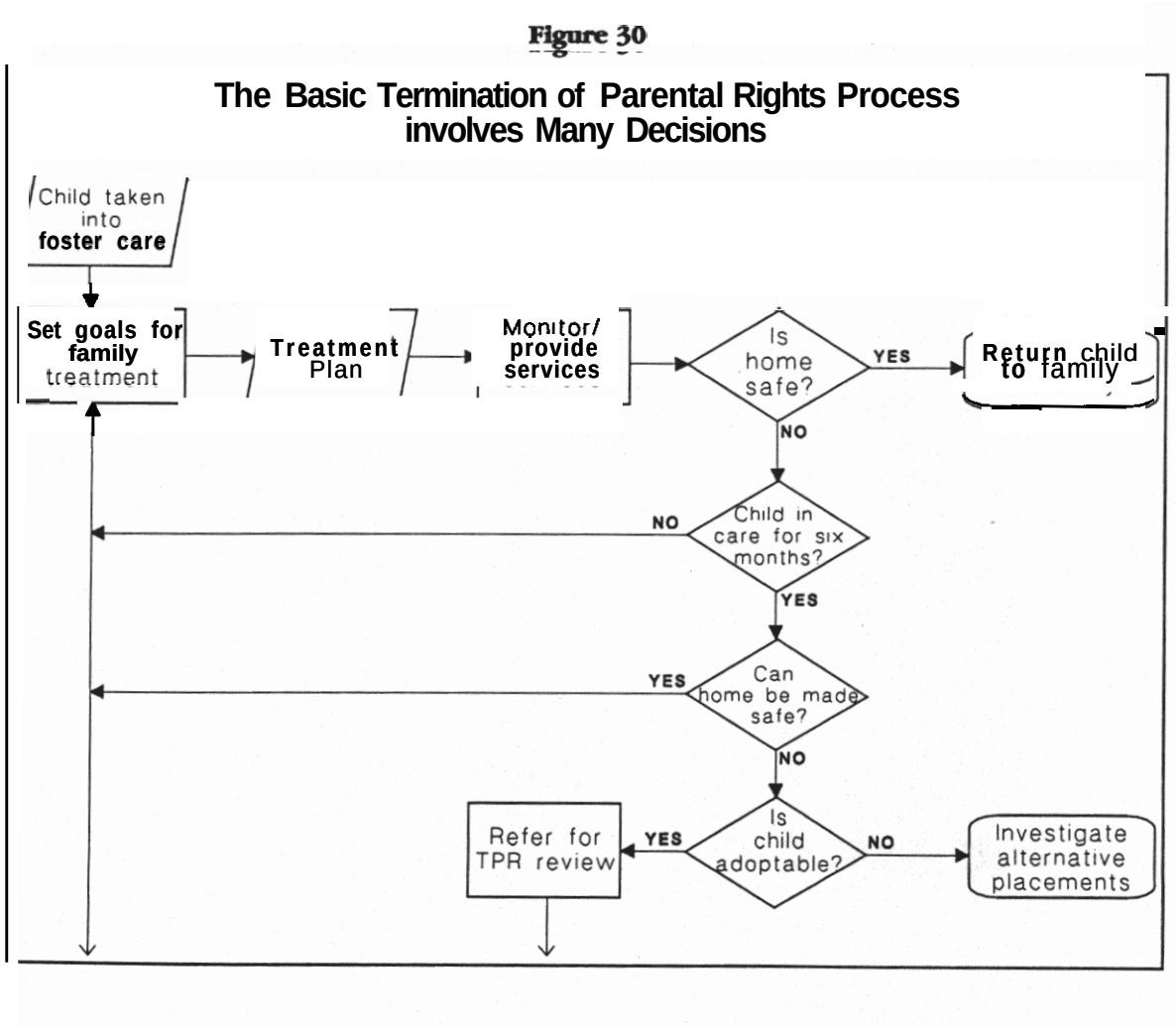
Specialized Graphics

Not all graphics indicate clear comparisons. These types of graphics are often intended to present information, emphasize a point, or entertain the reader or audience. Flow charts, time charts, maps, text charts, tables, and pictorials are common examples.

- **Flow** *chart*

A flow chart presents such information as a series of activities, procedures, operations, events, or other factors related to each other. (See Figure 30.) It shows the sequence or flow of these factors and any connections between factors. **Flow** charts ***are*** most helpful in achieving the objective of simplification. Flow charts can condense long and complex descriptions of a series of activities into a single chart that helps present information simply, clearly, and concisely. The flow chart also conveys the sense that steps or ideas have a systematic and coordinated relationship to each other and thus add coherence and unity to the presentation of information.

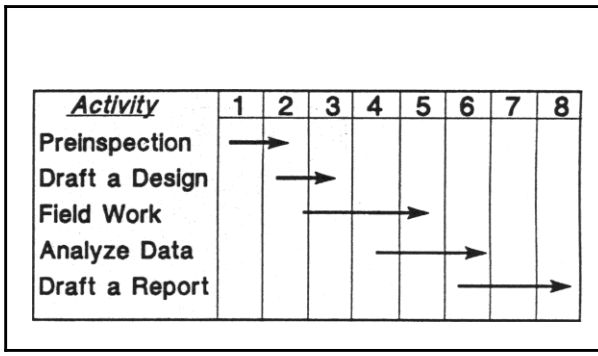
Figure 30



Many different formats are possible with flow charts since they are not bound by many of the more rigid rules accompanying many of the graphics forms described thus far. For this reason, they will test your ingenuity. Flow charts require a keen understanding of the process you wish to chart.

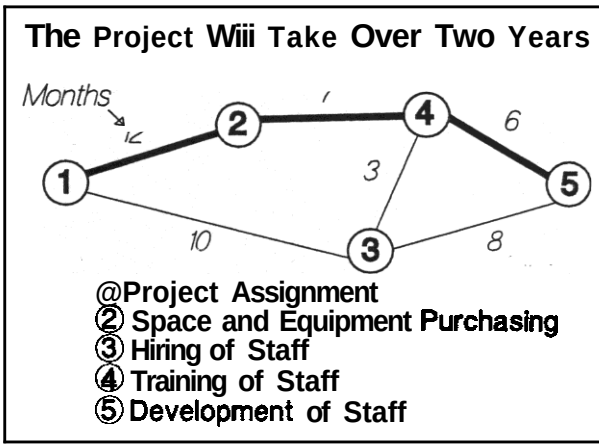
• **Time** Chart

A time chart shows a timetable for carrying out a series of activities, procedures, or tasks. The time chart is very effective in conveying concisely and clearly a good deal of detailed information regarding what is often a complex schedule of activities. The time chart includes a list of each activity and the time scheduled from its start to its completion.



tionship among all the scheduled events and activities and how they are interdependent for completion of a project. It shows the maximum period of time which can be taken to complete each step in a total process and still finish within an overall time frame.

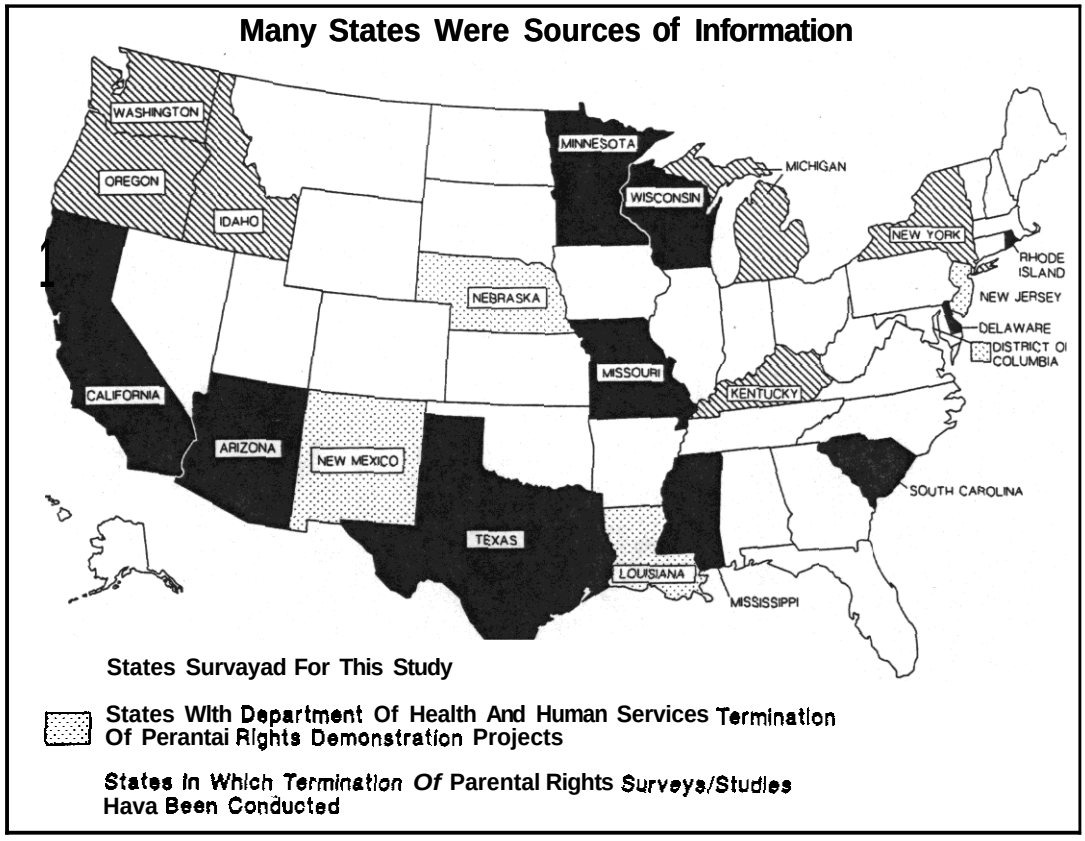
The Pert chart is composed of a series of circles joined by lines. In the chart depicted a circle represents an event. The line represents the activities which



• Map

Maps can compare differences between States. Usually this comparison in confiied to one piece of information about the State. Maps have the distinct disadvantage of implying that geographically larger States are more important, that within each State there are no distinctions, and that conditions change abruptly at State borders. In fact, none of these are likely to be true in most cases. As a result, maps should be used carefully when emphasizing differences between States. However, as depicted in Figure 33, maps can be used very effectively to simply reinforce something about States. In this case, readers can quickly see which States were surveyed for a study, participated in demonstration projects, or already have been studied.

Figure 33



• Text Chart

Text charts present focused narrative. (See Figure 34.) In briefings the text usually consists of bullet headers. In reports the text can be short or long and is usually placed in the report to emphasize a significant point or describe something (e.g., a best practice). Text charts in reports are generally bordered. You may add a shadow effect to the border for impact.

Figure 34

OEI Objectives

October 1, 1990 - September 30, 1992

- ✓ *Develop a Quality Improvement Initiative*
- ✓ *Improve Evaluation Processes and Reports*
- ✓ *Increase OEI's Relevance to Decision Makers*

• Table

except in the arrangement of numbers in columns and rows. (See Figure 35.) Table charts are most useful in the body of reports when the number of data points is less than 20 or in the appendix if more than 20. Additionally, if the number of data points is small, the table could be combined very effectively with a comparison graphic which plots the data in the table.

Several Carriers Do Not Verify Credentials

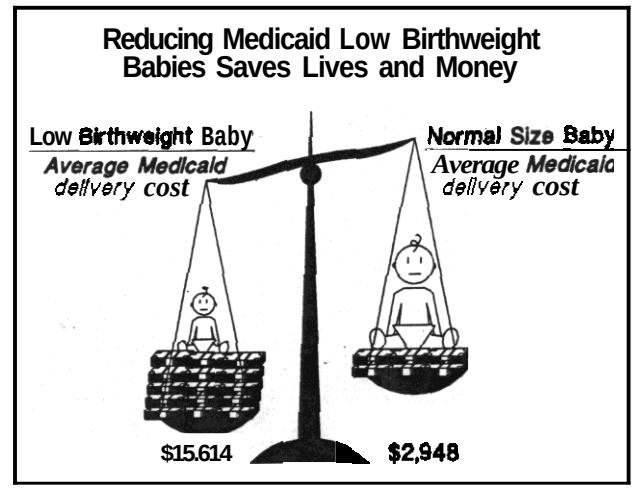
Provider	No Verification	
Medical Physician	6	16%
Osteopathic Physician	7	19%
Physician Assistant	11	30%
Dentist	8	22%
Chiropractor	6	16%
Psychologist	6	16%
Optometrist	7	19%
Podiatrist	6	16%
CRNA	2	5%

Prior to WordPerfect 5.1, we had to use either the text chart option of a presen-

• Pictorial

Pictorials encompass the representation of ideas or messages with the use of pictures. (See Figure 36.) Pictures can consist of electronic line art (e.g., clip art), photographs, or a combination. Creating such graphics are limited only by your imagination and the message you want to convey. Because of the serious nature of OEI work, pictorials should be used with great discretion (especially in reports).

Figure 36



• Pictograph

Pictographs enhance comparison graphics. Instead of a rectangular column or bar, symbols or images are used instead. (See Figure 37.) The same size symbols can be stacked on top of each other to create the bar or one symbol can be sized to the length of the column. These types of charts are popular in many magazines. This is for good reason. The areas, lies, bars, and pies of comparison graphics are abstract shapes that show data relationships more clearly than numbers alone. But because they are abstract, they have an inherent weakness. Symbols and images make a visual liii between the graphics bar, line, or pie and the topic. Because pictures and symbols have more emotional and persuasive power than numbers and abstract shapes, pictographs can have greater impact, especially in a briefiig.

Figure 37